MATERIAL MADE OF MINERAL FIBERS FOR ABSORBING IMPACT NOISE

The invention relates to a material comprising mineral fibers, intended to be placed beneath a wood floor so as in particular to absorb impact noise emitted inside the room in which it is placed. The invention relates especially to an assembly comprising, in a juxtaposed manner, a wood floor and a material comprising a felt of mineral fibers.

The improvement in the acoustic insulation of buildings (of any type, namely offices, dwellings, etc.) relates not only to the attenuation of the noise passing through the floor or the partitions, but also the attenuation of the noise emitted in a room in respect of the persons inside the same room. The invention firstly relates to this second type of acoustic insulation. Its purpose is therefore especially to attenuate, vis-à-vis a person in a room, the noise of impact with the floor (called "drum sound") emitted in the same room and especially that emitted by said person, for example the noise of his footsteps and more generally the noise of any impact with the floor. Within the context of the present application, this type of noise will be called "direct impact noise". However, the material according to the invention also acts by attenuating the noise passing through the floor or the partitions ("impact sound") which will be called in the context of the present invention "transmitted impact noise".

To attenuate direct impact noise in a room, it has already been proposed to place sheets of cork, sheets of polyethylene foam, a polyurethane mat, or a gum beneath the wood floor. However, these materials are generally heavy and expensive, or not very effective.

The material according to the invention helps to attenuate direct impact noise and transmitted impact noise. The material according to the invention comprises a felt of mineral fibers. This material has a thickness of a few mm and can be placed, taken from sheets or from a roll (if its flexibility so allows), beneath the entire surface of a wood floor. The term wood floor is to be taken in the broad sense, since the wood floors in question are not only wood floors made of wood blocks but more particularly wood floors called laminates, floating wood floors (comprising wood fiberboards in which the wood fibers are agglomerated in a binder, said fiberboard being combined, by means of an adhesive under pressure, with a decorative surface sheet) that can be laid as boards joined together by mortices and tenons. Within the context of the present invention, a laminated wood floor may be termed a "laminate".

The material according to the invention is in the form of a sheet comprising two parallel main faces. The mineral fibers may be glass fibers or rock fibers.

The felt of the material according to the invention comprises mineral fibers that may be prepared by the fiberizing process called internal centrifugation, or the "Aerocor" process or the "Rex" process (the latter process being particularly for rock fiber). The internal centrifugation process is preferred as it results in a felt that is particularly stable and particularly resistant to stretching and to bending.

The material according to the invention may especially be prepared by a process comprising the following steps:

- formation of the fibers (more particularly, glass fibers) by a spinner device for carrying out the internal centrifugation process; then

- spraying of a binder precursor onto the fibers; then
- collection of the fibers on a moving belt, in order to form a web; and then
- heat treatment of the web, according to a controlled thickness, so as to convert the binder precursor into a binder.

If necessary, a veil may be placed on the moving belt before fiberizing, the fibers then being collected on said veil. According to this variant, the material according to the invention comprises a felt and the veil bonded to one side of the felt. In general, the veil is bonded to the felt by the same binder contained in the felt. In particular, the veil makes the material according to the invention comfortable to use by those people handling it, since it limits direct contact between the skin and the mineral fibers.

This process may also be carried out by collecting the fibers directly on a moving belt (no veil at this stage) so as thereafter to affix at least one veil thereto, that is to say a veil on one main face or a veil on both main faces. The veil(s) may be applied to the mass of fibers before or after the heat treatment. If at least one veil if applied before the heat treatment, the binder precursor may be added between the veil and the fibers, and the heat treatment will be used to convert the binder precursor into binder both as regards that contained in the felt and as regards that serving to fasten the veil to the felt. If at least one veil is applied after the heat treatment, the veil may be fastened by any suitable product, including especially a hot-melt polymer, in which case said hot-melt polymer is applied hot.

The binder precursor, sprayed just after attenuation of the fibers, is converted into a binder during the heat treatment, said binder serving to bond the fibers

together, in order to give them a felt structure, and possibly also serving for bonding the optional veil to the felt. The binder creates bridging between the fibers. It is not necesssarily uniformly distributed around the individual fibers.

The moving belt is provided with holes so that by sucking air through the belt it is possible to attract said fibers onto the latter. If it is intended to collect the fibers on a veil entrained by the belt, air is sucked through the belt and the veil.

The principle of the internal centrifugation process is well known per se to those skilled in the art. Schematically, this process consists in introducing a stream of molten mineral material into a spinner, also called a fiberizing dish, rotating at high speed and pierced around its periphery by a very large number of holes via which the molten metal is forced out in the form of filaments owing to the effect of the centrifugal force. These filaments are then subjected to the action of an annular high-temperature high-velocity attenuation gas jet that hugs the wall of the spinner, which jet attenuates the filaments and converts them into fibers. The fibers formed are entrained by this attenuation gas jet toward a collecting device generally formed by a gas-permeable belt. This known process has formed the subject of many improvements, including especially those taught by patents EP 0 189 534, EP 0 519 797 or EP 1 087 912. This internal centrifugation process has been used, according to the prior art, to manufacture thermal insulation materials. This process is as it were deflected from its original purpose in the present invention since here its purpose is above all to reduce impact noise. Compared with these felts made for thermal insulation, the felts used for the present invention have a high density, a high binder content and a very small thickness.

French patent application No. 02/06547 filed on May 27, 2002 may also be cited as a document of the prior art.

Preferably, the fibers of the felt have a fineness index ranging from 3 to 25 liters per minute and preferably ranging from 10 to 15 l/min. These preferred values correspond approximately to the following "micronaire" values: from 2.3/5 g to 2.7/5 g.

Preferably, the felt has a density ranging from 40 to 120 kg/m^3 and preferably from 60 to 100 kg/m^3, for example about 80 kg/m^3. The mass per unit area of the felt is generally between 80 and 1200 g/m^2, preferably at least equal to 130 g/m^2, especially ranging from 130 to 700 g/m^2 and even more preferably from 180 to 700 g/m^2.

In general, the felt includes binder in an amount from 3 to 30 and more generally from 5 to 25% by weight, especially 6 to 16% by weight.

The material according to the invention may have a thickness ranging from 2 to 10 mm, preferably ranging from 3 to 7 mm, for example about 4 mm. The same applies to the felt.

Thus, the felt comprising mineral fibers may have a thickness ranging from 2 to 10 mm and a mass per unit area of at least 130 g/m^2.

The fiberizing parameters are adapted so that the fibers obtained by the fiberizing process have the desired fineness index, said fineness index being measured by the technique described in French patent application No. 02/06252 filed on May 22, 2002. This French patent application No. 02/06252 relates in fact to a device for determining the fineness index of

fibers, comprising a device for measuring the fineness index, said device for measuring the fineness index being provided, on the one hand, with at least a first orifice connected to a measurement cell suitable for receiving a specimen consisting of a plurality of fibers, and on the other hand, with a second orifice connected to a device for measuring a differential pressure on either side of said specimen, said device for measuring the differential pressure being intended to be connected to a device for producing a flow of fluid, characterized in that the device for measuring the fineness index includes at least one flow meter for measuring the volume of the fluid flowing through said cell. This device gives correspondences between "micronaire" values and liters per minute, provided that the fiber is thick enough for micronaire values to exist.

The sprayed binder precursor may be of the phenolic or acrylic or epoxy type. Depending on its nature, this precursor may be sprayed in the form of a solution or of an emulsion. The mass sprayed generally contains a high proportion of water, for example a water content ranging from 70 to 98%, especially about 90%. The rest of the sprayed mass comprises the binder precursor and optionally an oil and optionally additives such as, for example, a silane, in order to optimize the interface between the fiber and the binder, or a biocide. The sum of the amounts of oil and additive will generally be from 0 to 5% by weight of the mass of precursor, especially from 1 to 3% by weight of the mass of precursor. The oil may especially be that of the MULREX 88 brand. In general, the binder is of the thermosetting type.

The mineral material that is converted into fiber is generally glass. Any type of glass that can be converted by the internal centrifugation process may be suitable. In particular, the glass may be a lime

borosilicate glass, and especially a biosoluble glass. The mineral fiber may also be a rock fiber.

The heat treatment enables the binder precursor to be converted into a binder by causing chemical solidification (crosslinking or curing) reactions and by evaporating the volatile species (solvent, reaction products, etc.). After this heat treatment, the fibers are bonded together in the felt and, as the case may be, the felt is bonded to the optional veil. This operation is carried out while keeping the thickness of the felt constant during the solidification reaction, this generally being accomplished by keeping the felt (combined, as the case may be, with the optional veil) between two moving belts placed at a constant distance apart, said distance corresponding to that desired for the final material. The felt is in fact compressed right from the start of its passage between the two belts so that the felt generally decreases in thickness on passing into the heat treatment.

To obtain a given final felt thickness, it is generally necessary to deposit, on the moving belt, a layer of fibers (before compression during the heat treatment) having a thickness ranging from 15 to 60 times the desired final thickness. To give an example, for a felt having a final thickness of about 4 mm, it is necessary to deposit a layer of fibers with a thickness ranging from 100 to 150 mm before the heat treatment.

The material according to the invention may be formed from the bonded felt and include no other layer. However, it may also include a veil on one of its sides or a veil on both its sides.

Generally, the material according to the invention comprises 2 to 12% by weight of veil, the rest generally consisting of the felt (it is considered here that the mass of the felt includes the mass of the

binder, including that used for bonding the veil to the felt).

One method of preparing a material comprising the felt and a veil has already been given above, this veil being unwound onto a belt in order to receive the fibers being formed. It is also possible to manufacture the felt separately and without a veil, and then to bond the veil or veils to one or both its sides. The one or more optional veils are generally made of polyester or polypropylene or glass, and generally have a mass per unit area (or grammage) ranging from 5 to 100 g/m^2.

In order to store it, the material according to the invention may be wound up or cut into square or rectangular sheets (for example having an area ranging from 0.1 to 0.4 m^2).

To furnish a floor base according to the invention, the procedure is generally as follows:

- sheets of the material according to the invention, having the same lengths and widths as the laminate boards that it is desired to lay, are prepared; then
- assemblies, each comprising a laminate board and a sheet of the material according to the invention, are prepared by bonding the sheets of the material according to the invention to the underside of the laminate boards; and then
- the above assemblies produced are laid on the floor base.

In this situation, and if the material according to the invention includes a veil, the veil is generally on the external side of the assembly so that it is the veil that is in contact with the floor base.

The wood floor may or may not be adhesively bonded to the material according to the invention. To do this, it is possible to use, for example, a conventional wood adhesive. In particular, it is possible to use an adhesive of the INSTAWELD 6621 brand. Preferably, the wood floor is adhesively bonded to the material according to the invention. In general, the material according to the invention and the wood floor are bonded together beforehand and then, in a second step, the bi-component material thus obtained is laid on the floor base. This operation of laying on the floor base is generally carried out without adhesive, since this makes it easier for the moisture in the floor base (for example the residual moisture of the concrete) to escape.

If the flexibility of the material according to the invention allows it to be wound, it is also possible to lay the material according to the invention onto the floor base by means of a reel and then to lay the wood floor (with or without adhesive).

The material according to the invention acts as acoustic insulation for any building and especially dwellings. The invention therefore also relates to a building that includes a wood floor/material according to the invention assembly.

The material according to the invention reduces impact noise, especially at a frequency between 50 and 5000 Hz. The material of the invention is particularly effective for reducing impact noise of high frequency, in particular of frequency above 700 Hz, even above 1000 Hz and even above 1500 Hz, for example between 1500 and 5000 Hz. These measurements of the influence on impact noise may be carried out according to the EN-ISO140-8 and ISO 717/2 standards.

Figure 1 shows schematically a process for manufacturing a material according to the invention, comprising a felt and a veil. The process involved here is the internal centrifugation process. A stream of molten mineral material 1 (especially glass) drops down at the center of the hollow shaft 2 of the spinner, touches the basket 3 and then said material is thrown by centrifugation against the fiberizing dish 4 provided with holes. The molten material passes through the holes in the form of fibers, which are then attenuated by means of the burners 5. The spray nozzles 6 spray the binder precursor onto the fibers, said fibers then being collected on the veil 7 which is itself driven along by a gas-permeable belt 8. Suction (not indicated in figure 1) acts through the belt in order to attract the fibers to the surface of the veil and to hold them thereon. The fiber/veil assembly is then driven into an oven 9 in order to convert the binder precursor into binder. In this oven, the material is gripped between two moving belts 10 and 11 separated from each other by the desired distance for the final thickness of the material. After the binder has solidified, the material according to the invention can be wound up at 12.

Figure 2 shows the material according to the invention, which here comprises a veil 13 on which a felt of fibers 14 is bonded.

EXAMPLES

A felt of bonded glass fibers was prepared by the internal centrifugation process, the characteristics of which were the following:

- fineness index: 10 l/min;
- density: 80 kg/m^3;
- binder content: 10% by weight;
- thickness: 4 mm.

During its manufacture, the glass fibers were deposited on a polyester veil whose mass per unit area was 20 g/m^2. This veil was bonded to the felt by the same binder as that contained in the felt.

The following were installed on the concrete screed of a room:

- the material according to the invention was laid over one third of the area, the veil of which was in contact with the floor base, and then a floating wood floor made of a laminate comprising agglomerated wood fibers was laid (without adhesive);
- an extruded polyethylene foam of the "Pergo Underlay Foam" brand was laid over another third of its area and then the same wood floor was laid (without adhesive); and
- the wood floor was laid directly on the concrete screed over another third of its area, without interposition of any other material (and therefore without adhesive either).

Ten people with normal hearing were asked to walk on the three areas of the floor and then indicate the area on which they hear their own steps the least. All ten indicated that the area furnished with the material according to the invention was the best from this standpoint.